THE RAFFLES BULLETIN OF ZOOLOGY 2002 **50**(1): 37-52

DESCRIPTIONS OF TWO NEW SPECIES OF THE GENUS *GAMMARUS* (CRUSTACEA: AMPHIPODA: GAMMARIDAE) FROM YUNNAN, CHINA

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ABSTRACT. - Two new species of the genus *Gammarus* are described and illustrated based on specimens collected from Yunnan Province, China. *Gammarus paucispinus,* new species and *G. lophacanthus,* new species belong to *G. pulex*-group and *G. balcanicus*-group, respectively. *Gammarus paucispinus* resembles *G. gregoryi* Tattersall (1924) but differs in relatively long inner ramus of uropod 3. *G. lophacanthus* is characterized by urosomites 1-2 with a medial cluster of 3-4 spines on posterodorsal margin.

KEY WORDS. - China, Amphipoda, *Gammarus,* taxonomy, new species.

INTRODUCTION

The province Yunnan is located in the southwest region of China. It covers an area of 394,000 km^2, with altitudes varying from 74 m in the southern parts of the province to 5586 m in the northwest region. The physical geography of northerly Tibet Plateau in combination with southeastern and – western monsoons results in clinal climate changes at different levels of altitude. Yunnan is characterized by a zonation of landscape from snow-capped, high mountains to the lowland tropical rainforest. The Yunnan landscape yields a high level of biodiversity. Thus, the following percentages of the Chinese vertebrate species were found in Yunnan: 41% of freshwater fishes, 40% of amphibians, 38.7% of reptiles, 64.4% of birds, and 51.4% of mammals (Ji, 1999).

Although Yunnan also has a rich invertebrate fauna, the freshwater amphipods of this region are still poorly known. Up to now, there are five species reported from Yunnan: *Jesogammarus (Annanogammarus) annandalei* (Tattersall, 1922), *Gammarus gregoryi* Tattersall, 1924, *G. taliensis* Shen, 1954, *Fuxiana yangi* Sket, 2000, and *G. qiani* Hou & Li, 2002. To better clarify the biodiversity of amphipods in Yunnan, we have examined the "Mt. Hengduanshan collections" deposited in the Institute of Zoology, Chinese Academy of Sciences (IZCAS). This collection was made during scientific expeditions organized by Chinese Academy of Sciences in Mt. Hengduanshan, a part of Qinghai-Tibet plateau from 1981 to 1994. In this paper, two new species of freshwater Amphipoda are described based on "Mt. Hengduanshan collections".

All the holotypes and allotypes in the present study are deposited in IZCAS. Parts of paratypes are deposited in the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research, National University of Singapore.

TAXONOMY

Gammarus paucispinus, new species
(Figs. 1-6)

Material examined. - Holotype - male, 6.5 mm (IZCAS-I-A0018), Gezanqianjin, Zhongdian County (27.7°N, 99.7°E), Yunnan province, China, 13 Aug.1981.

Allotype, female, 6.9mm (IZCAS-I-A0019); same locality. Paratypes - 10 males and 8 females (IZCAS), Napahai, Zhongdian County, Yunnan, 4 Sep.1981; 19 males, 11 females (IZCAS), Reshuitang, Tuanjiegongshe, Xiaozhongdian, Zhongdian County, Yunnan, 1 Sep.1981; 6 males, 9 females (IZCAS), 20 males and 20 females (ZRC 2002.094), Bigu Foresty Centre, Xiaozhongdian, Zhongdian County, Yunnan, 2 Sep.1981; 15 males, 9 females (IZCAS), Shuoduoganghe River, Xiaozhongdian, Zhongdian County, Yunnan, 1 Sep.1981.

Diagnosis. - *Gammarus paucispinus* is a relatively small species distinguished by the following

Received 15 Nov 2001 Accepted 26 Mar 2002

diagnostic characters: Peduncular articles 4-5 of antenna 2 with 8-9 groups of setae, setae a little longer than width of peduncle; flagellum without calceoli. Inner plate of maxilla 2 with only 8 diagonal plumose setae on inner face. Carpus and propodus of gnathopod 1 elongate. Pereopods 3-4 densely setose, with long setae on posterior margins of articles. Pereopod 6 longer than pereopods 5 and 7, anterior lobes of coxal plates 5 and 6 relatively small. Inner ramus of uropod 3 about half as long as outer ramus, terminal article of outer ramus shorter than adjacent spines, both rami with long simple setae. Urosomite 1 only with a few short setae, spines absent.

Description of male. - holotype, 6.5 mm. Inferior antennal sinus distinct; eyes ovate (Fig. 2A). Antenna 1 (Figs. 1B, M): peduncles bearing few setae, length ratio of peduncular articles 1.0 : 0.7 : 0.42; primary flagellum 23-articulate, most articles with aesthetascs; accessory flagellum 4-articulate. Antenna 2 (Fig. 1C): gland cone not reaching peduncular article 4; peduncle densely setose; article 3 with distal setae, articles 4 and 5 subequal in length, both with 3-4 groups of setae along anterior and posterior margins, and 3-4 clusters of setae on inner face; flagellum 12-articulate, each article with clusters of setae; calceoli absent.

Upper lip (Fig. 1D) convex, with minute setae. Left mandible (Figs. 1I, J): incisor 5-dentate, lacinia mobilis with 4 dentitions, spine row with about 6 plumose setae, molar with 1 plumose seta; second article of palp bearing 11 setae, article 3 with 3 A-setae on outer face, 3 B-setae on inner face, 18 D-setae and 4 E-setae. Right mandible (Fig. 1H): incisor 4-dentate; lacinia mobilis bifurcate, with weak dentitions. Lower lip (Fig. 1F) concave, inner plate absent. Maxilla 1 (Figs. 1K, L): inner plate bearing 11 plumose setae; outer plate with 11 serrated spines; second article of left palp with 6 slender spines and 2 setae apically; article 2 of right palp with 5 blunt spines, 1 slender spine and 1 stiff seta. Maxilla 2 (Fig. 1G): inner plate with 8 plumose setae on inner face, outer plate a little longer than inner plate. Maxilliped (Fig. 1E), inner plate with 3 blunt, apical spines and 1 subapical spine; outer plate broad, bearing 11 spade spines and 7 pectinate setae on apical and subapical margins.

Gnathopod 1 (Figs. 2E, F): coxal plate weakly dilated distally, bearing 2 setae on anterior corner and 1 seta on posterior corner; basis with long setae on anterior and posterior margins, and 3 stiff setae distally; carpus and propodus elongate, length ratio 1.0 : 1.1, carpus with subparallel anterior and posterior margins; palm of propodus strongly oblique, bearing 1 median spine, about 5 pairs of spines on posterior margin and 5 short spines on inner face; dactylus with 1 seta on outer margin and 3 setae at hinge of nail. Gnathopod 2 (Figs. 2D, G): coxal plate bearing 3 setae and 1 seta on anterior and posterior corners respectively; basis similar to that of gnathopod 1; length ratio of carpus and propodus 1.0 : 1.2, shape of carpus subequal to that of gnathopod 1, but bearing more and longer setae on margins; palm of propodus broader than that of gnathopod 1; palm medial spine large and rounded, posterior corner with 1 medium sized and 6 small spines.

Pereopod 3 (Figs. 3A, H): coxal plate similar to that of gnathopod 2; articles 2-5 densely setose, with long, sometimes curled setae on posterior margin; articles 5 and 6 armed with 5 groups of 1-2 spines on posterior margin; dactylus with 1 plumose seta on anterior margin and 1 stiff seta distally, nail about as long as base. Pereopod 4 (Figs. 3B, I): coxal plate with posterior excavation, bearing 3 setae on anterior corner and 6 setae on posterior margin; armature of articles 4-6 weaker than those of pereopod 3.

Pereopod 6 longer than pereopods 5 and 7 (Figs. 4A-C, G-I). Anterior lobes of coxal plates 5 and 6 small, posterior lobe bearing 2-3 setae; shape of coxal plate 7 irregular, bearing 2 setae on posterior margin. Bases of pereopods 5-7 slightly convex anteriorly, bearing 5 short spines and several long, proximal setae; posterior margin nearly straight in pereopod 5, weakly concave in pereopod 6, relatively expanded in pereopod 7, with ca. 10 short setae respectively; bases of pereopods 5 and 6 with posterodistal lobe, basis of pereopod 7 with 1 spine on inner face. Articles 4-6 with groups of spines accompanied by short setae. Dactylus about 30% as long as article 6.

Coxal gills on pereopods 2-7, ovoid (Figs. 4A, C), coxal gill of pereopod 7 small (Fig. 4C).

Epimeral plates 1-3 (Fig. 2C) with 1-2 short setae on posterior margin. Epimeral plate 1 ventrally rounded, with 2 setae on anterior corner; posterior margin of epimeral plate 2 nearly straight, ventrally bearing 3 marginal spines and 1 submarginal spine; posterior corner of epimeral plate 3 not acute, with 3 spines on ventral margin. Pleopods 1-3 subequal (Figs. 3C-E), peduncles with 4-15 setae, bearing 2 retinaculae accompanied by 1-2 setae; rami with 8-12 articulates, fringed with plumose setae.

Urosomites 1-3 (Figs. 1A, 2B) without humps dorsally, urosomite 1 with a few short setae; urosomites 2 and 3 with 4 and 2 singly arranged spines accompanied by setae respectively, setae longer than spines. Uropod 1 (Fig. 4D): peduncle longer than rami, bearing 1

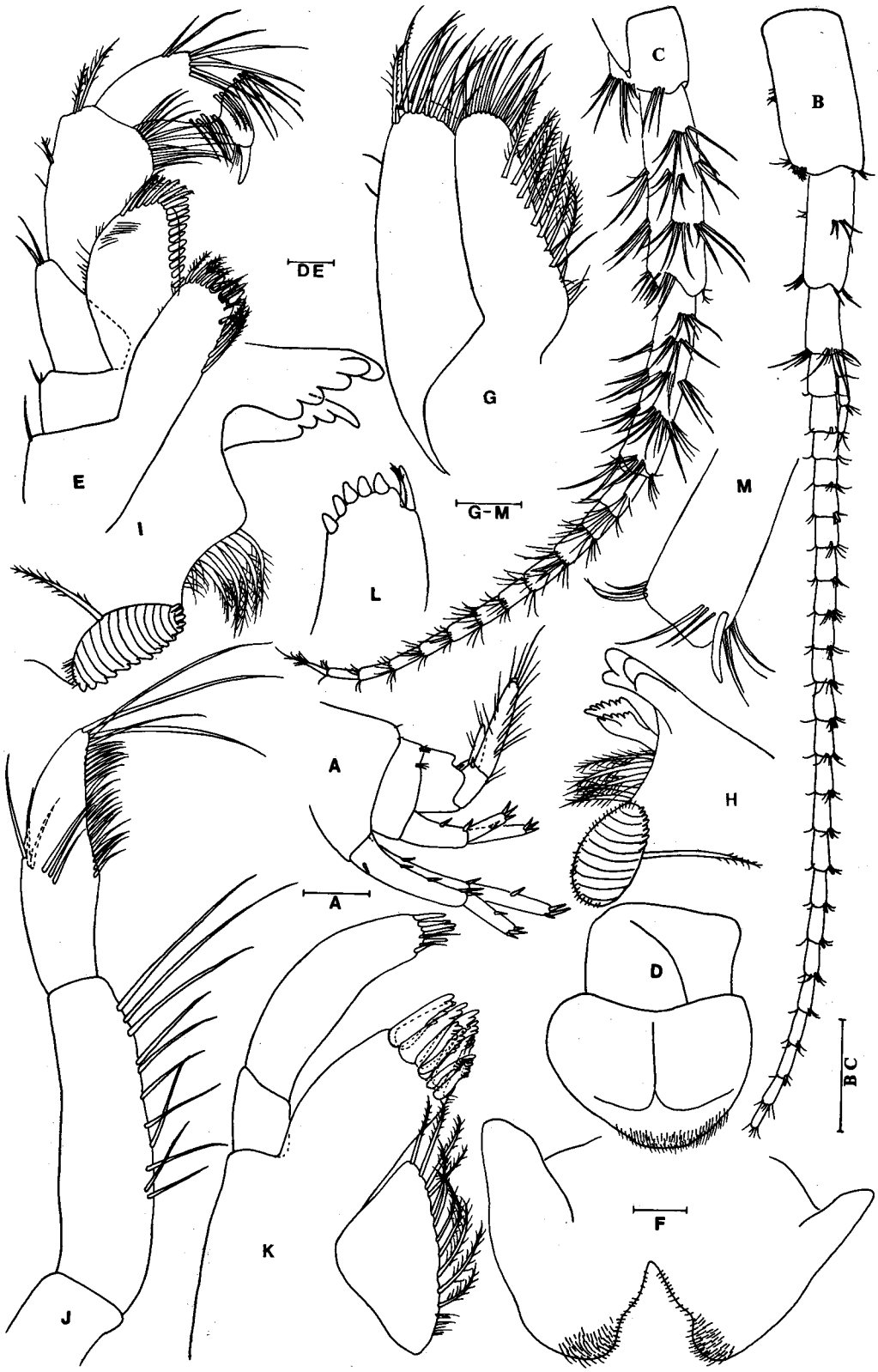

Fig. 1. *Gammarus paucispinus,* new species, male, holotype. A. urosomites 1-3 (lateral view), B. antenna 1, C. antenna 2, D. upper lip, E. maxilliped, F. lower lip, G. maxilla 2, H. incisor of right mandible, I. incisor of left mandible, J. palp of left mandible, K. left maxilla 1, L. palp of right maxilla 1, M. flagellum of antenna 1. Scales: A-C = 0.5mm; D-M = 0.1mm.

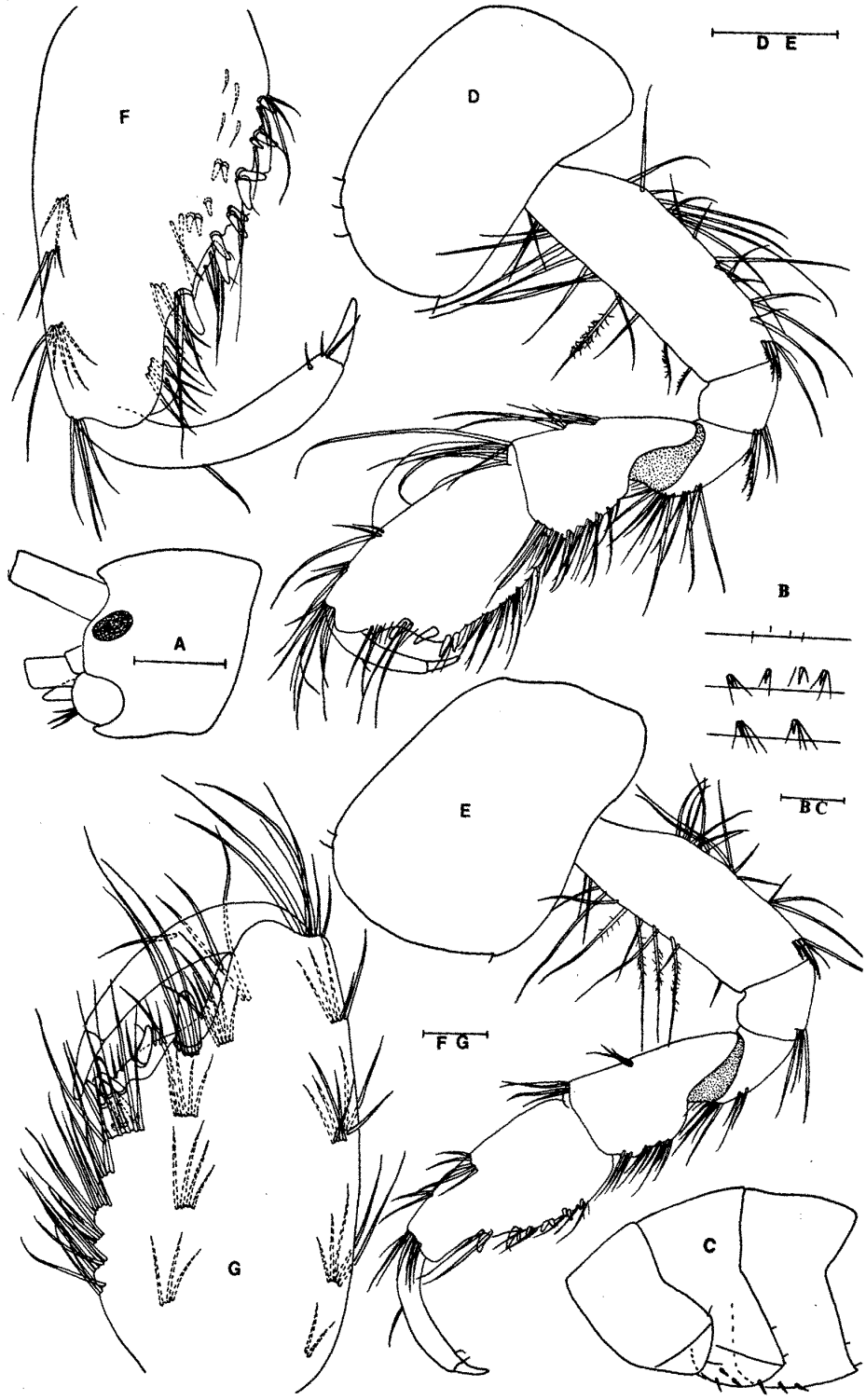

Fig. 2. *Gammarus paucispinus,* new species, male, holotype. A. head, B. urosomites 1-3 (dorsal view), C. epimeral plates D. gnathopod 2, E. gnathopod 1, F. propodus of gnathopod 1, G. propodus of gnathopod 2. Scales: A-E = 0.5mm; F, G = 0.1mm.

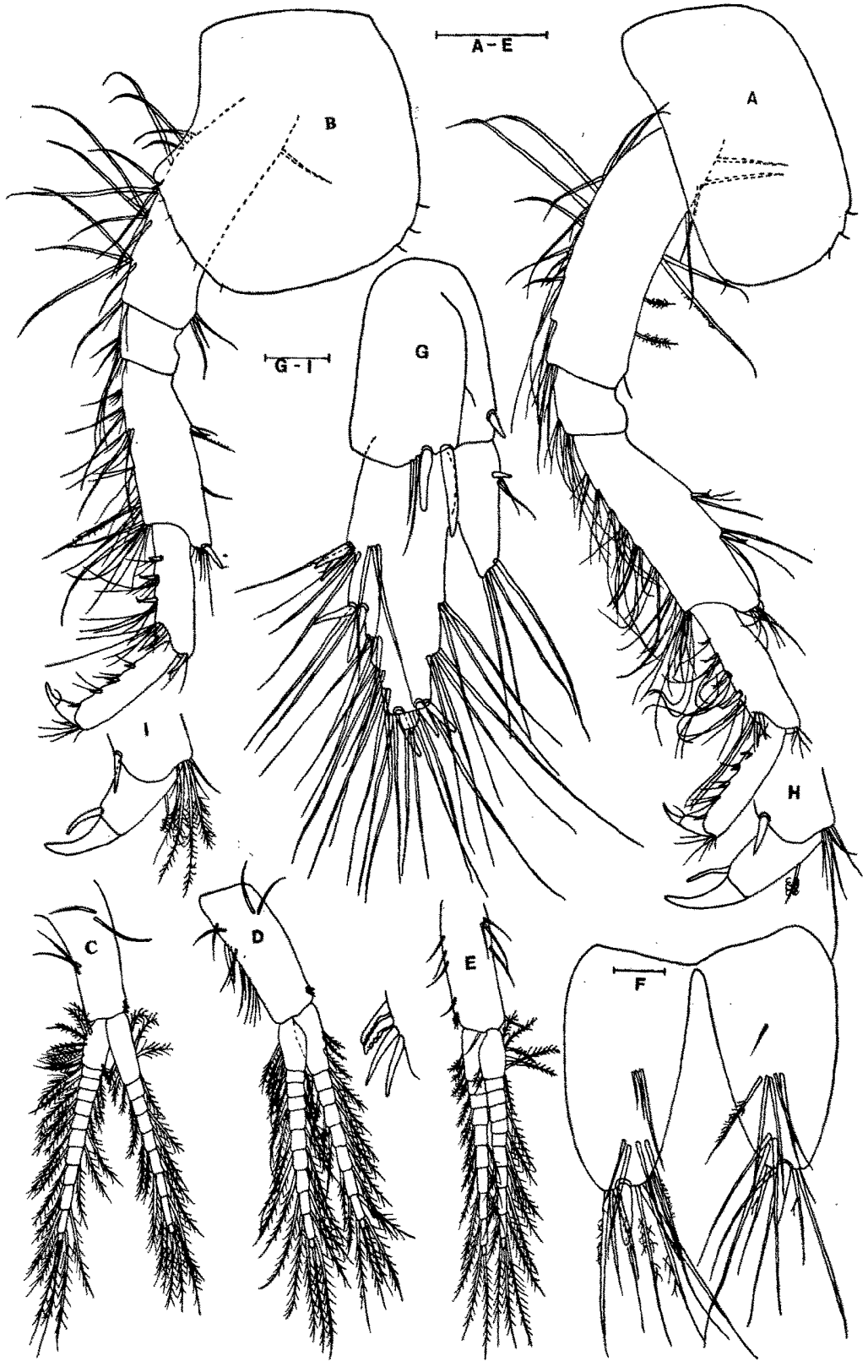

Fig. 3. *Gammarus paucispinus,* new species, male: A-F, female: G. A. pereopod 3, B. pereopod 4, C. pleopod 1, D. pleopod 2, E. pleopod 3, F. telson, G. uropod 3, H. dactylus of pereopod 3, I. dactylus of peropod 4. Scales: A-E = 0.5mm; F-I = 0.1mm.

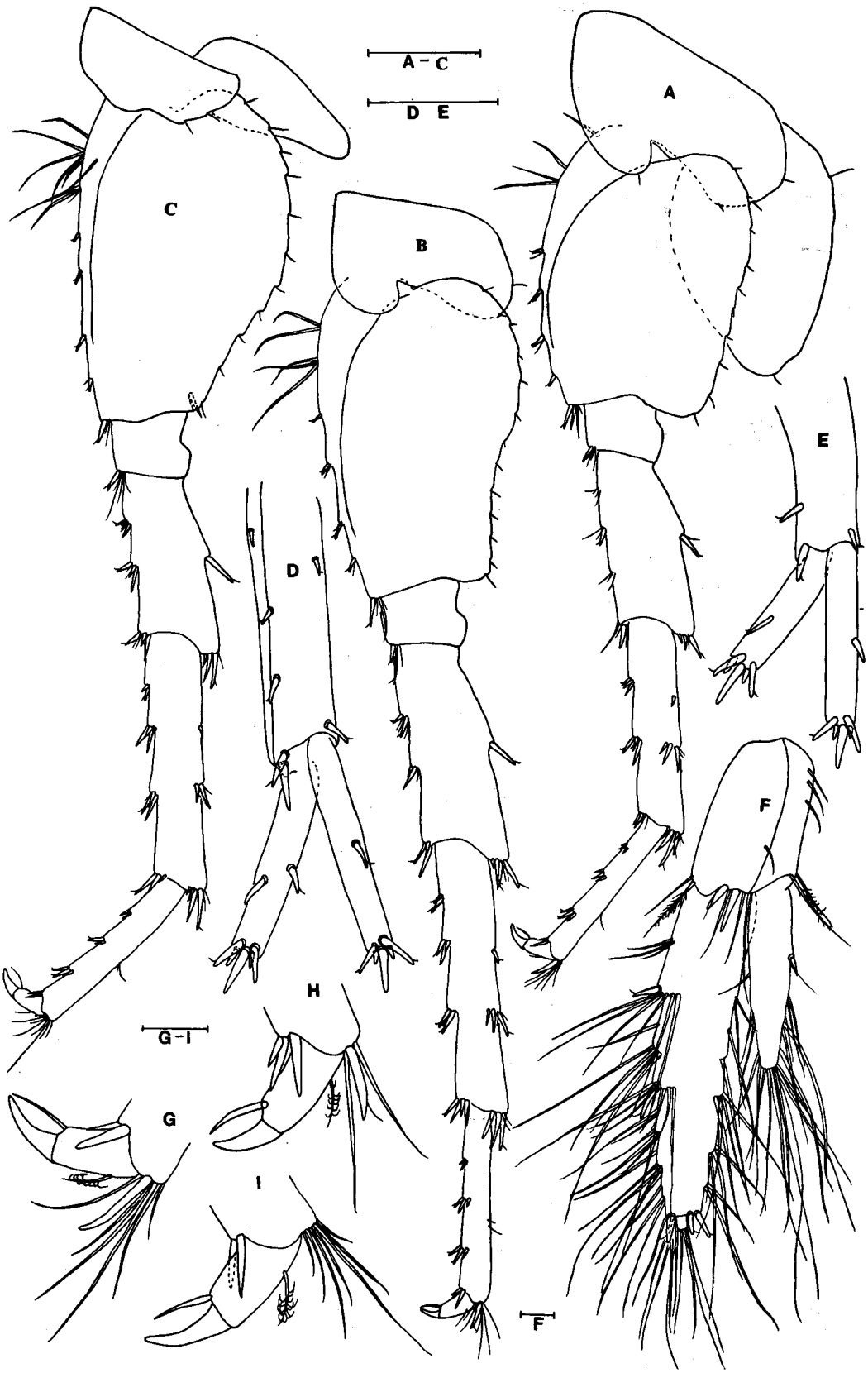

Fig. 4. *Gammarus paucispinus,* new species, male, holotype. A. pereopod 5, B. pereopod 6, C. pereopod 7, D. uropod 1, E. uropod 2, F. uropod 3, G. dactylus of pereopod 5, H. dactylus of pereopod 6, I. dactylus of pereopod 7. Scales: A-E = 0.5mm; F-I = 0.1mm.

Fig. 5. *Gammarus paucispinus,* new species, female, allotype. A. gnathopod 1, B. gnathopod 2, C. pereopod 6, D. telson, E. propodus of gnathoopod 1, F. propodus of gnathopod 2. Scales: A-C = 0.5mm; D-F = 0.1mm.

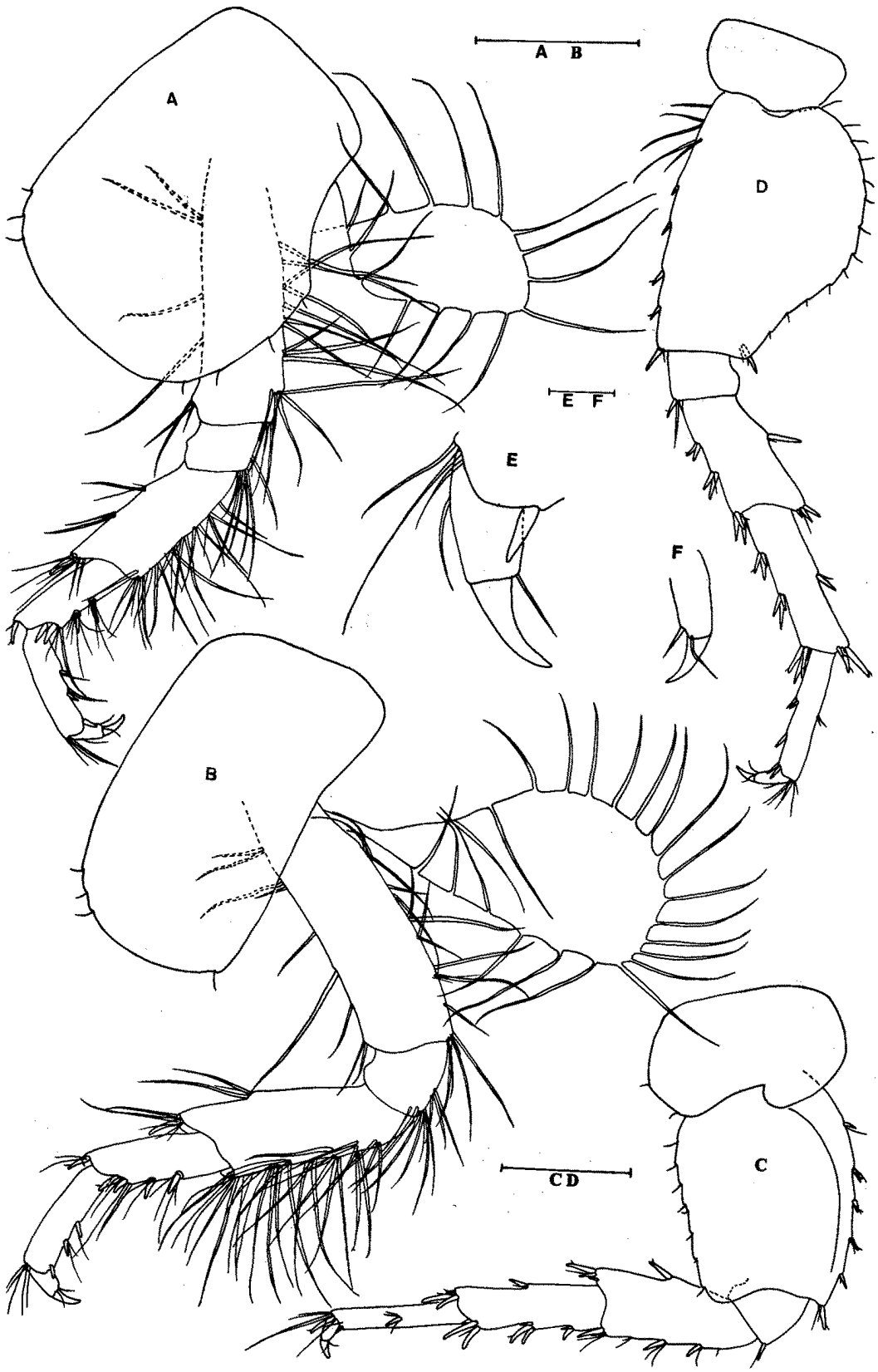

Fig. 6. *Gammarus paucispinus,* new species, female, allotype. A. pereopod 4, B. pereopod 3, C. pereopod 5, D. pereopod 7, E. dactylus of pereopod 4, F. dactylus of pereopod 7. Scales: A-D = 0.5mm; E, F = 0.1mm.

basofacial spine, outer margin and inner margin with 4 and 2 spines, respectively; rami subequal in length. Uropod 2 (Fig. 4E): peduncle with 1 dorsolateral and 2 distal spines; outer ramus shorter than inner ramus. Uropod 3 (Fig. 4F): peduncle with dorsal setae and distal spines accompanied by setae; inner ramus about half of outer ramus; outer ramus 2-articulate, article 1 with 2 marginal spines and 3 distal spines, terminal article shorter than adjacent spines; both rami with numerous long, simple setae.

Telson (Fig. 3F) wider than length, deeply cleft, each lobe with 1 distal spine accompanied by 5-7 long setae and 2 groups of long setae on dorsal face.

Description of female. - A 6.9 mm female differs from the male in the following characters: Gnathopod 1 (Figs. 5A, E) smaller than that of male, carpus short, propodus ovoid, palm of propodus obique, with 3 spines on posterior corner. Propodus of gnathopod 2 (Figs. 5B, F) subrectangular, palm transverse, with 3 spines on posterior corner. Pereopods 3-4 (Figs. 6A, B, E) similar to those of male, armature less-developed. Uropod 3 (Fig. 3G) stouter than that of male, both rami with fewer setae than those of male. Telson (Fig. 5D) relatively short. Oostegites on pereopods 2-5 increasing progressively in size; oostegite 2 larger than gill, with some marginal setae; oostegite 3 about as large as gill, oostegite 4 elongate; oostegite 5 longer than coxa.

Etymology. - The specific name *paucispinus* refers to the poorly spinose urosomites, bearing dorsally comparatively few spines and setae.

Remarks. - *Gammarus paucispinus,* new species belongs to *G. pulex*-group defined by Karaman & Pinkster (1977). This species resembles *G. gregoryi* Tattersall (1924) from River Lijiang, Yunnan, a species that also has only a few dorsal setae and no spines on urosomite 1. But it differs from *G. gregoryi* by the following characters: inner ramus of uropod 3 bout 50% of outer ramus (33% in *G. gregoryi*); lateral lobe of head truncate in *paucispinus,* obliquely truncate, with both upper and lower angles rounded in *gregoryi;* flagellum of antenna 2 without calceoli in *paucispinus* (with calceoli in male *gregoryi*).

Gammarus laticoxalis Karaman, 1977, found in Syria, also has only a few dorsal setae on urosomite 1. However, *G. laticoxalis* can be easily distinguished from *G. paucispinus* by a distally strongly dilated coxal plate 1, and both rami of uropod 3 armed with plumose setae.

Distribution. - Zhongdian County, Yunnan province, China (present study).

Gammarus lophacanthus, new species
(Figs. 7-11)

Material examined. - Holotype - male, 7.4 mm (IZCAS-I-A0020), Lake Heilongtan in Baiyi, Songming County (25.3°N, 103.0°E), Yunnan Province, China, 11 Jan.1994.

Allotype, female, 6.9 mm (IZCAS-I-A0021). Paratypes - 12 males, 5 females (IZCAS), paratypes - 2 males, 7 females (ZRC 2002.095), same locality as holotype.

Diagnosis. - *Gammarus lophacanthus* is easily recognizable within *G. balcanicus*-group by the following characters: Flagellum of antenna 2 without calceoli. Urosomites 1-2 with 1 cluster of 3-4 spines on posterodorsal margin medially. Peduncle of uropod 1 without basofacial spine. Uropod 3 slender, with a few setae, outer ramus 1-articulate, inner ramus about 80% length of outer ramus.

Description of male. - holotype, 7.4mm. Body slender. Eyes as long as the diameter of peduncular article 1 of antenna 1, ovate; lateral lobe obliquely truncate (Fig. 8H). Antenna 1 (Figs. 7A, G): length ratio of peduncular articles 1.0 : 0.72 : 0.43, with several distal setae; flagellum 18-20 articulate, most articles with aesthetascs; accessory flagellum 3-articulate. Antenna 2 (Fig. 7B): gland cone beyond peduncular article 3, peduncular articles 4 and 5 subequal in length, article 4 bearing 2 clusters of setae on both margins and 3 groups of setae on inner face, article 5 with 3 groups of setae along anterior and posterior margins, inner face with 3 clusters of setae, setae shorter than width of peduncle; flagellum 9-articulate, each article with a row of setae on distal margin, setae length shorter than article length, calceoli absent.

Upper lip (Fig. 7C) convex, covered with minute setae. Left mandible (Figs. 7E, F): incisor 5-dentate, lacinia mobilis with 4 weak dentitions, spine row bearing 6 plumose setae, molar triturative, bearing 1 long plumose seta; second article of palp bearing 12 stiff setae, article 3 about 80% as long as article 2, with 4 A-setae on outer face, 3 B-setae on inner face, 20 D-setae and 4 E-setae. Right mandible (Fig. 7I): incisor 4-dentate, lacinia mobilis bifurcate. Lower lip (Fig. 7D) concave, inner plate absent. Maxilla 1 (Figs. 7G, L): inner plate with 11 plumose setae, outer plate bearing 11 serrated spines, second

article of left palp bearing 6 slender spines and 2 setae apically; article 2 of right palp with 6 blunt spines and 1 stiff seta. Maxilla 2 (Fig. 7H): inner plate with a diagonal row of 10 plumose setae on inner face; outer plate a little longer than inner plate, with many apical setae. Maxilliped (Fig. 7K): inner plate bearing 3 blunt, apical spines and 1 subapical spine, outer plate with 9 blade-spines on medial margin and 5 pectinate setae on apical margin; article 2 of palp stout, article 4 unguis-form.

Gnathopod 1 (Figs. 8B, C): coxal plate weakly dilated distally, bearing 1 seta on anterior corner and 1 seta on posterior corner; basis with long setae on anterior and posterior margins, bearing stiff setae distally; carpus tri-angular shaped; propodus about 1.5 times of carpus in length, palm of propodus strongly oblique, bearing 1 median spine, 8 spines on posterior margin and 2 spines on inner face; dactylus bearing 1 seta on outer margin, unguis short. Gnathopod 2 (Figs. 8A, D) a little larger than gnathopod 1, coxal plate subrectangular, with 3 setae and 1 seta on anterior and posterior corners, respectively; basis with many long marginal setae, bearing 3 spinulate setae distally; carpus with subparallel anterior and posterior margins, bearing 5 groups of setae along posterior margin; propodus 1.37 times as long as carpus, palm transverse, bearing 1 blunt median spine and 6 spines on posterior corner; dactylus with 1 seta on outer margin.

Pereopod 3 (Figs. 9A, G) slender, with a few setae; coxal plate similar to that of gnathopod 2, article 2 with long marginal setae; article 4 with 4 groups of short setae on posterior margin; article 5 with 3 groups of 2-3 spines on posterior margin; article 6 with 4 pairs of spines on posterior margin; dactylus curved, bearing 1 seta on outer margin and 1 stiff seta at hinge of nail. Pereopod 4 (Figs. 9B, H) similar to pereopod 3, armature less developed.

Pereopods 6 and 7 longer than pereopod 5 (Figs. 10A-C, G-I). Anterior lobe of coxal plates 5 and 6 small, posterior corner with 1 short seta; coxal plate 7 with 3 setae on posterior margin. Anterior margin of bases weakly convex, with 6 short spines and several long, proximal setae; posterior margin nearly straight in pereopod 5, weakly concave distally in pereopod 6, evenly convex in pereopod 7, with ca. 10 short setae. Articles 4-6 with groups of spines, and very few setae. Dactylus slender, bearing 1 spinulate seta on outer margin and 1 stiff seta at joint of nail.

Coxal gills on pereopods 2-7 ovoid (Figs. 8A, 9A, B, 10A, B), coxal gill of pereopod 7 small.

Epimeral plates 1-3 (Fig. 8G) progressively acuminate on posterior corner, with 1-2 setae on posterior margin. Epimeral plate 1 ventrally rounded, bearing 6 setae on anterior corner; plate 2 with 3 setae on anterior corner and 1 spine on ventral margin; plate 3 with 2 short setae and 2 spines on ventral margin. Pleopods 1-3 subequal (Figs. 9C-E) in length, peduncles with some setae, bearing 2 retinaculae accompanied by 2 setae; rami with 12-16 articles, ornamented with plumose setae.

Urosomites 1-2 (Figs. 8E, F) flat, with 1 cluster of 3-4 spines on dorsal margin medially, urosomite 3 with 2-1-1-2 spines on posterodorsal margin. Uropod 1 (Fig. 10D): peduncle without basofacial spine, with 1-1-2 and 1-1-1 spines on outer and inner margins, respectively; outer ramus a little shorter than inner ramus, with 2 spines on each side; inner ramus with 2 spines on outer margin. Uropod 2 (Fig. 10E): peduncle with 3 and 2 spines on outer and inner margins; outer ramus shorter than inner ramus. Uropod 3 slender (Fig. 10F), with a few long setae, peduncle bearing 3 spines on distal margin and 3 short setae dorsally; inner ramus 78% as long as outer ramus, bearing 3 lateral and 2 distal spines; outer ramus 1-articulate, bearing 2 clusters of lateral spines and 4 distal spines accompanied by short setae.

Telson cleft deeply (Fig. 9F), longer than wide, each lobe bearing 2 distal spines accompanied by 1 short seta, and 1 short dorsal seta.

Description of female. - A 6.9mm, ovigerous female (with 6 eggs, eggs relatively large) differs from the male in the following characters: Carpus of gnathopod 1 (Figs. 11E, G) about as long as propodus; palm of propodus not oblique as that of male, bearing 8 spines on posterior margin and 3 spines on inner face. Basis of gnathopod 2 (Figs. 11D, H) with more setae than that of male, carpus elongate; palm of propodus truncate, bearing 3 spines on outer face and 3 spines on inner face. Pereopods 3-7 (Figs. 11A-C) similar to those of male. Oostegites 2-5 broad (Fig. 11F), with many marginal setae. Uropod 3 (Fig. 9J) with fewer setae than in male, inner ramus 70% length of outer ramus. Telson (Fig. 9I), bearing 2-3 spines distally.

Etymology. - This specific name *lophacanthus* alludes to the urosomites 1-2 with 1 cluster of spines on mid-dorsal margins.

Remarks. - *Gammarus lophacanthus,* new species, belongs to *G. balcanicus*-group defined by Karaman & Pinkster (1987). This new species is the first one

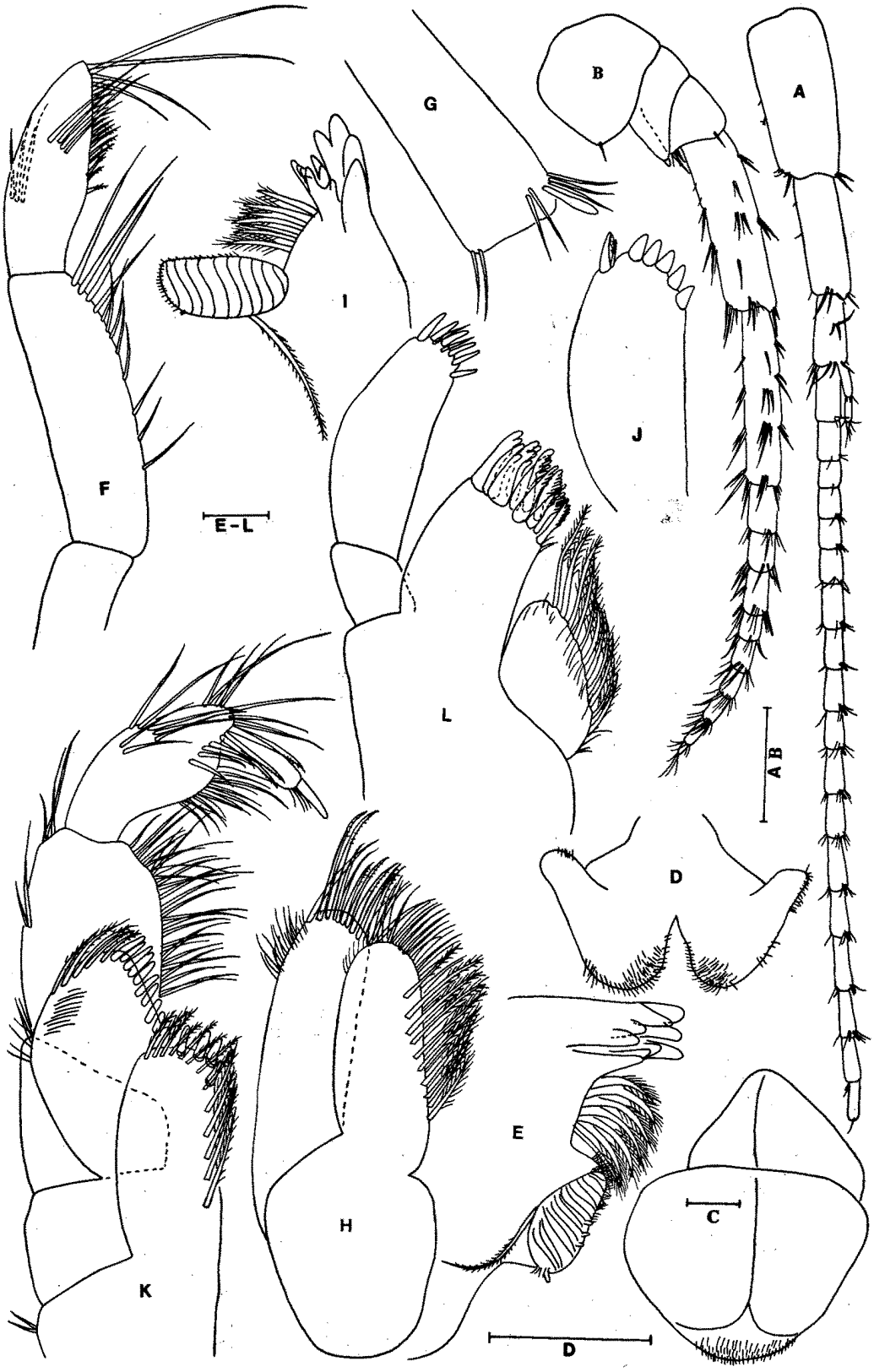

Fig. 7. *Gammarus lophacanthus,* new species, male, holotype. A. antenna 1, B. antenna 2, C. upper lip, D. lower lip, E. incisor of left mandible, F. palp of left mandible, G. flagellum of antenna 1, H. maxilla 2, I. incisor of right mandible, J. palp of right maxilla 1, K. maxilliped, L. left maxilla 1. Scales: A, B, D = 0.5mm; C, E-L = 0.1mm.

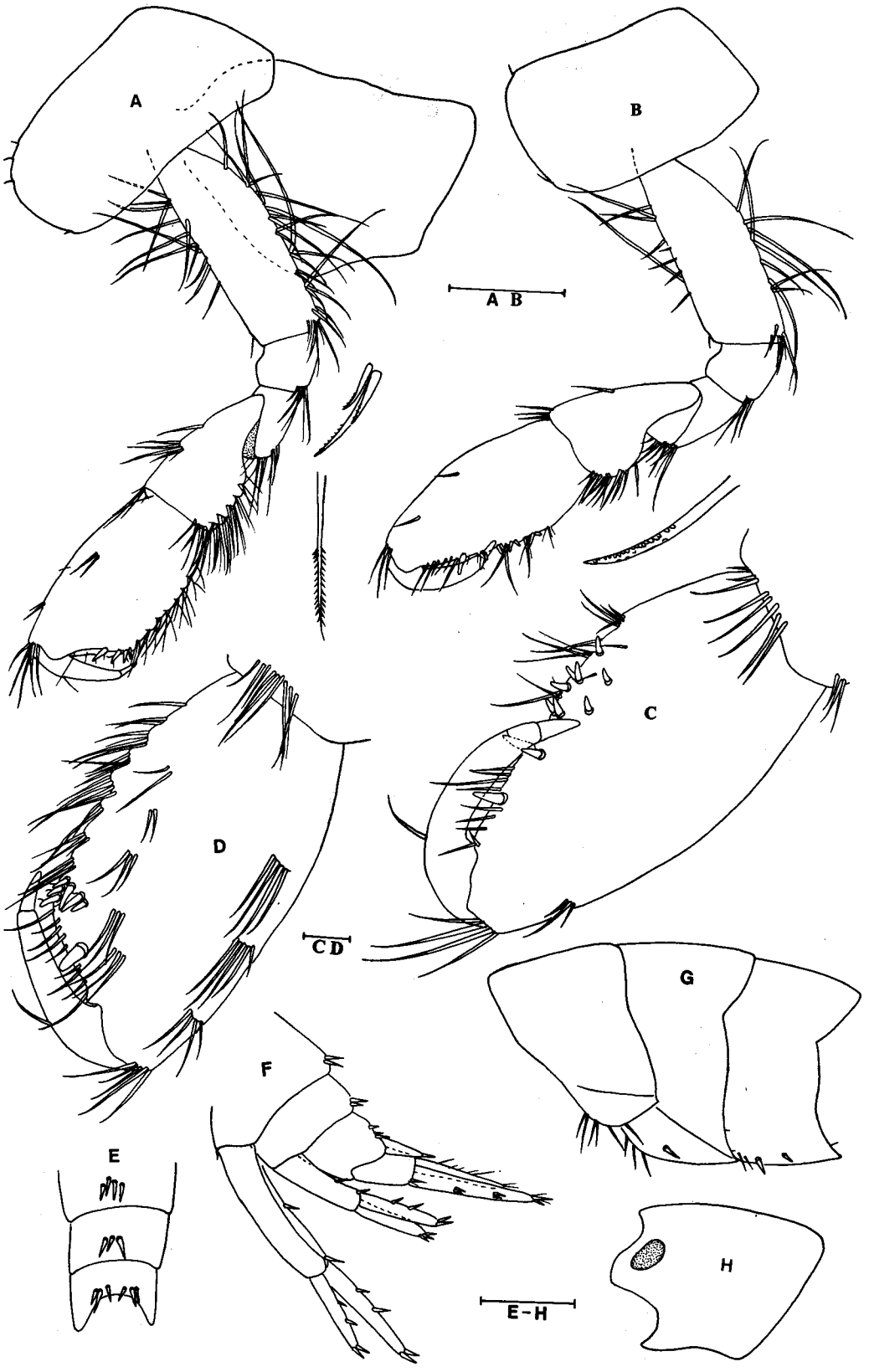

Fig. 8. *Gammarus lophacanthus,* new species, male, holotype. A. gnathopod 2, B. gnathopod 1, C. propodus of gnathopod 1, D. propodus of gnathopod 2, E. urosomites 1-3 (dorsal view), F. urosomites 1-3 (lateral view), G. epimeral plates 1-3, H. head. Scales: A, B, E-H = 0.5mm; C, D = 0.1mm.

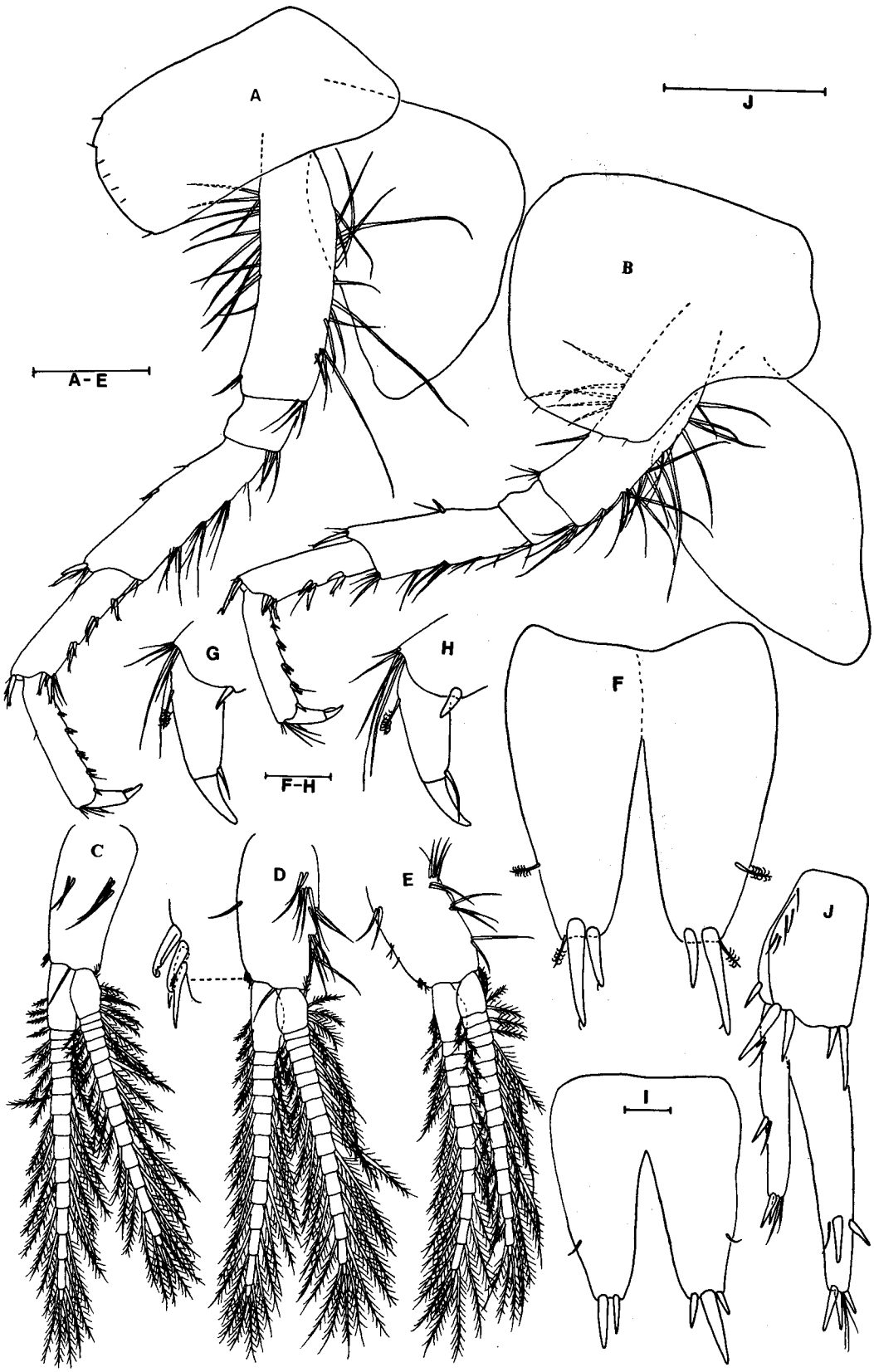

Fig. 9. *Gammarus lophacanthus,* new species, male: A-H; female: I, J. A. pereopod 3, B. pereopod 4, C. pleopod 1, D. pleopod 2, E. pleopod 3, F. telson, G. dactylus of pereopod 3, H. dactylus of pereopod 4, I. telson, J. uropod 3. Scales: A-E, J = 0.5mm; F-I = 0.1mm.

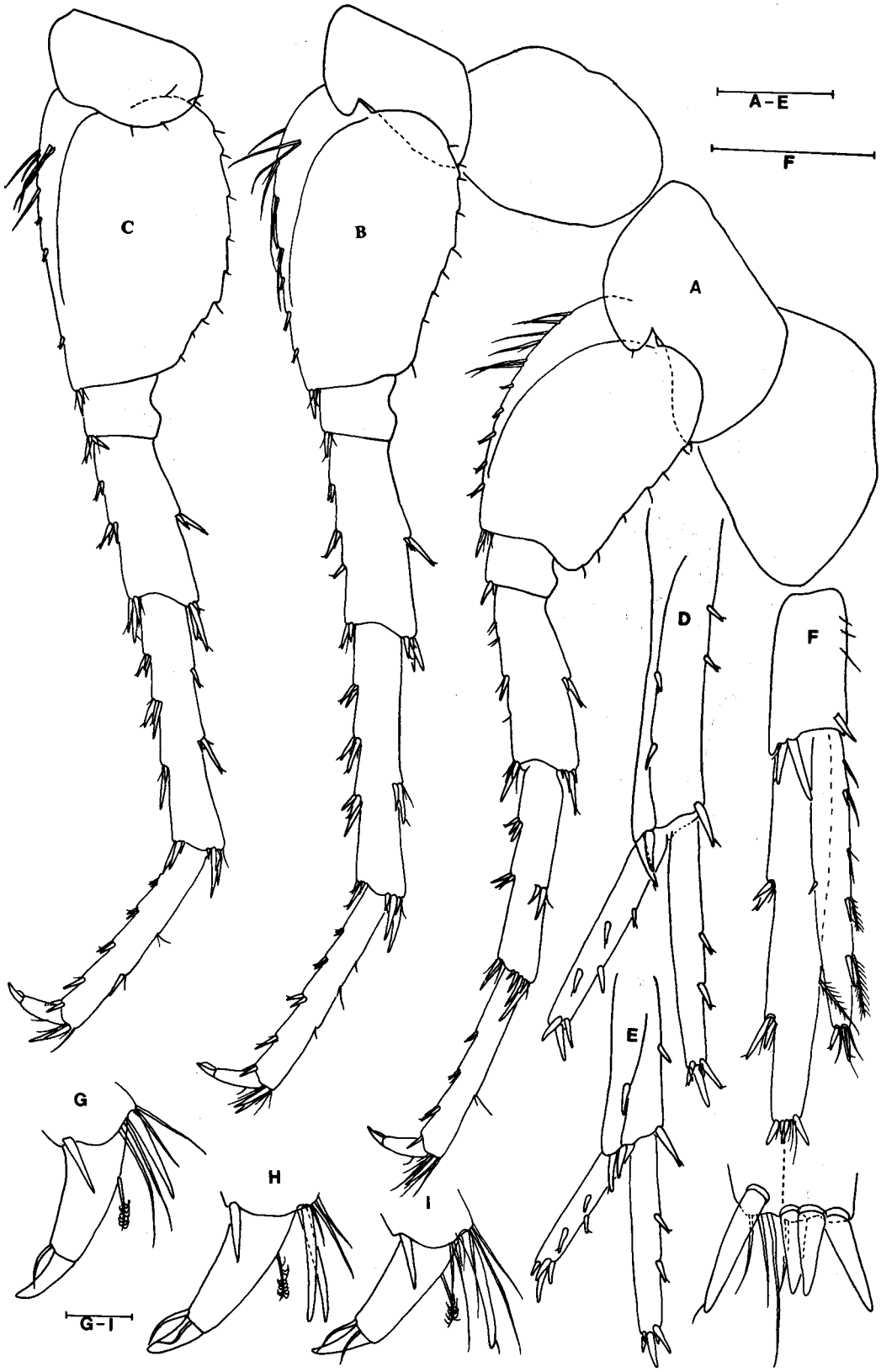

Fig. 10. *Gammarus lophacanthus,* new species, male, holotype. A. pereopod 5, B. pereopod 6, C. pereopod 7, D. uropod 1, E. uropod 2, F. uropod 3, G. dactylus of pereopod 7, H. dactylus of pereopod 6, I. dactylus of pereopod 5. Scales: A-F = 0.5mm; G-I = 0.1mm.

Fig. 11. *Gammarus lophacanthus,* new species, female, allotype. A. pereopod 5, B. pereopod 6, C. pereopod 7, D. gnathopod 2, E. gnathopod 1, F. oostegite of gnathopod 2, G. propodus of gnathopod 1, H. propodus of gnathopod 2. Scales: A-F = 0.5mm; G, H = 0.1mm.

known from China which belongs to *G. balcanicus*-group, so it can be clearly distinguished from the other Chinese *Gammarus* (Barnard & Dai, 1988; Karaman, 1989) by pereopods 3-4 and uropod 3 with few long setae.

Within *G. balcanicus*-group, eighteen species has been recorded by Karaman & Pinkster (1987). However, *G. lophacanthus* distinctively differs from them by antenna 2 without calceoli, urosomites 1-2 with only 1 cluster of 3-4 spines on posterodorsal margins, and outer ramus of uropod 3 with 1 article.

Distribution. – Songming County, Yunnan Province, China (present study).

ACKNOWLEDGEMENTS

We are very grateful to Dr. Stefan Koenemann and Dr. Dirk Platvoet (University of Amsterdam, the Netherlands) for their continued support and encouragement throughout present study. Thanks are also due to Mr. Guoxiao Chen (IZCAS) for the donation of material used in this study. The present study is supported by the National Natural Sciences Foundation (Grant No. 39970102), also partly supported by the President Foundation of the Chinese Academy of Sciences, Grant for systematic and evolutionary biology, CAS, and Special support project of the department of Biology, CAS (STZ-00-19).

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